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## THE CONTROL OF INSECTS ATTACKING APPLE AND PEAR

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U. S. Department of Agriculture

## APPLE INSECTS

The apple tree is subject to attack by many different species of insects, but only a few usually become seriously destructive. The control measures recommended apply to the more important insects, although the same practices aid considerably in controlling most of the insect pests of lesser importance.

## The San Jose Scale

The San Jose scale infests the wood, leaves, and fruit of the apple and many other fruit trees. When present on a tree in large numbers, the scales lower its vitality by sucking the juices from plant tissues, and in cases of extreme infestation may kill individual branches or entire trees. The mature scale is about the size of a pinhead, circular in outline, and grayish in color. The bark of badly infested trees is ash gray and, when cut into, shows a reddish discoloration.

Control.--The San Jose scale is usually controlled by spraying the trees thoroughly once each year with one of the petroleum-oil sprays or with lime-sulphur. The spray should be applied late in the fall after the leaves have dropped, during warm periods in the winter, or early in the spring. The oil emulsions or miscible oils may be obtained ready-prepared, or the emulsions may be prepared on the farm. Directions for making the emulsions will be found in Farmers' Bulletin No. 1676, entitled "Lubricating-oil Sprays for Use on Dormant Fruit Trees", a copy of which may be obtained from the Office of Information, United States Department of Agriculture. The oil emulsions that are bought ready made should be diluted in accordance with the recommendations on the label. The home-made preparations should be diluted to contain 2 to 3 percent of actual oil, except in the Northwest, where 4 percent is needed. If lime-sulphur is to be used, the standard concentrated solution (testing 32 to 33° Baumé) should be diluted 1 part in 7 parts of water. For a few dooryard trees a strong solution of soap may be used.

## European Red Mite

In recent years the European red mite has done considerable damage in a number of fruit districts. The tiny mites cause a bronzing and weakening of the foliage, which in heavy infestations results in more or less defoliation. These creatures pass the winter in the form of tiny red eggs on the twigs and smaller branches of the trees. These eggs may be destroyed by thorough applications of lubricating-oil emulsion at from 3 to 4 percent strength, or by the use of miscible oils at the dilution recommended by the manufacturer. The applications are most effective if they are made in the spring just as the buds are beginning to swell. Lime-sulphur is not very effective as a dormant spray for the eggs of the mite, although during the summer it has considerable value against the active stages.



## Apple Aphids

Several kinds of aphids are often found on apple trees, the most important being the rosy apple aphid. These aphids hibernate as tiny black eggs on the twigs and in crevices in the bark. On the first warm days of spring, just as the buds start pushing out, these eggs hatch and the aphids congregate on the opening buds. As soon as the leaves develop, the tiny aphids cause them to curl. Later, when the apples form, the aphids cause a serious stunting and distortion of the fruit. In June the rosy apple aphid migrates from the apple trees to entirely different food plants, chiefly to the long-leaved plantain, and does little further damage to apple during that season. The green apple aphid, however, is present on the trees in varying numbers throughout the growing period.

Control.—The most satisfactory time for controlling the apple aphids is early in the spring, when the newly hatched insects are clustered on the swelling buds and before they are protected by the curled leaves. This is often referred to as the delayed dormant period. Thorough spraying with nicotine sulphate at this time usually prevents serious damage later in the season. One pint of nicotine sulphate (40 percent nicotine) should be used to each 100 gallons of spray (1 teaspoonful to a gallon). This should be used with the dormant-strength lime-sulphur solution which is applied for the control of the San Jose scale early in the spring, or with water to which a small quantity of soap has been added. The various oil sprays, if applied during the delayed-dormant period, have some value in the control of the apple aphids, but are much less dependable than the lime-sulphur-nicotine combination. The addition of nicotine to oil sprays increases their effectiveness in the control of the apple aphids. Under some conditions, particularly in the Northwest, the oil sprays may cause injury to the unfolding buds if applied after the leaves have begun to push out.

The green apple aphid may become abundant during the summer, producing large quantities of sticky honeydew, which supports the growth of a black mold. It also does considerable damage to the fruit and foliage, often distorting the young shoots. Comparatively little can be done to control the aphids after the trees are in foliage, because so many of the insects are protected from the spray material by the curling of the leaves. Emphasis should therefore be placed on the control of the aphids during the delayed-dormant period.

## The Codling Moth or Apple Worm

The codling moth, or apple worm, is the dirty white or pinkish caterpillar that is so often found in apples. The worms pass the winter in tightly woven cocoons in crevices under the bark, in the dead wood in old pruning scars, in coarse trash on the ground, in picking boxes, in crevices in the packing shed, and in other similar locations. Shortly after the apple trees come into bloom the adult moths begin to emerge and lay tiny white, scalelike eggs on the leaves and later on the fruit. The first worms hatching from these eggs begin entering the small apples 3 to 4 weeks after the petals have fallen, the exact date varying with seasonal conditions. In many southern localities the insect passes through 2 or 3 generations, and sometimes even a fourth generation, during the season.

Control.—The control of the codling moth involves a number of repressive measures, starting during the winter with the removal and destruction of rough



trash in the orchard and the scraping of the trees to remove loose bark and destroy hibernating worms. These practices are also necessary in preparation for the use of bands, which should be placed on the trunks of the trees about the first of June and remain until harvest time. Chemically treated bands, which kill the worms entering them, are available, and their use obviates the necessity of examining the bands periodically and killing the worms by hand. The thinning and destruction of wormy fruit early in the season is also of value. These practices should be used in conjunction with timely and thorough spraying.

The spray program for the control of the codling moth starts with the so-called petal-fall or calyx application, which should be made within a few days after most of the petals have fallen, while the blossom end of the newly formed apple is open. A large proportion of the worms later enter through the blossom end, and the poison must be placed there before the calyx lobes have closed over. The insecticide for use in this application is lead arsenate. In general this poison should be applied at a strength of 1 to 1 1/2 pounds of the powdered material to 50 gallons of water (3 to 5 teaspoonfuls per gallon). Growers in most localities add a fungicide (usually lime-sulphur), and sometimes about twice as much fresh high-calcium hydrated lime as lead arsenate in order to prevent foliage injury. The calyx spray should be followed 3 to 4 weeks later by the so-called first cover spray in order to protect the surface of the fruit from the newly hatched worms. Commercial growers use several applications of lead arsenate later in the season. As a result, sufficient lead and arsenic residues may accumulate on the fruit to be injurious to human health. The excess is removed, however, by washing the fruit in dilute hydrochloric acid and then thoroughly rinsing it. This reduces the poison residues well below the point dangerous to health. Persons with a few dooryard trees should remove the poison by scrubbing the fruit thoroughly, or by peeling it, before it is consumed.

A general spray schedule for apples is given at the end of the section on Apple Insects.

### Plum Curculio

The plum curculio is one of the causes of knotty and deformed apples. This small snout beetle punctures the young fruit early in the spring while feeding and laying its eggs, causing much of the fruit to fall or to become misshapen, thereby destroying it or lessening its market value. In addition, the beetle, while feeding in the fall, makes small holes in the ripening fruit, furnishing entrance for various kinds of rots.

Control.--In severe infestations applications of lead arsenate in addition to those recommended in the regular schedule are needed for about 4 weeks following petalfall, when the curculios are most active. In unusually severe infestations an application 7 days after the calyx spray and another 10 days later are needed; in moderately severe infestations a single application 10 days after the calyx spray is sufficient. In the case of orchards in sod, or surrounded by weeds or brush, spraying is not fully adequate, and these unfavorable conditions should be corrected if possible.



## Apple Maggot

The apple maggot, known also as the railroad worm, makes discolored patches or winding burrows here and there in the flesh of the apple. Several of them working in an apple usually reduce the pulp to a slimy brownish mass, even though externally the apple may appear perfect. The insect is more or less prevalent throughout the Northeastern States. It prefers sweet and subacid varieties, especially those that ripen during the summer or early in the fall.

Control.—The apple maggot may be controlled by keeping the foliage and fruit covered, during July, with a poison, such as lead arsenate, which destroys the flies before egg laying has proceeded to any extent. It is essential to spray all infested trees, since the proximity of sources of infestation often neutralizes any benefit that might otherwise result from the application of lead arsenate. In the home orchard and elsewhere care should be taken to gather and promptly destroy wormy, fallen fruit.

Since the use of lead arsenate in the control of the apple maggot may result in residue dangerous to health, it must be removed by washing before the fruit is consumed or placed on the market.

## Apple-Spraying Schedule

The schedules given herein are general in nature and require modification to adapt them to the needs of each particular locality. In many cases a greater number of applications is needed. More detailed information should be obtained from the local county farm advisor, the State Extension Service, or the State Experiment Station.



General Spray Schedule for Apples

Appli- cation	Timing	Materials	To Control
Dormant or Delayed dormant	At any time(except dur- ing freezing weather) after leaves drop in the fall until buds start swelling in the spring As the buds are break- ing and before they have pushed out more than 1/4 inch	Oil emulsion 2 to 4 percent, miscible oil as recommended by manufacturer, or lime-sulphur 1-7 Nicotine sulphate 1/2 pint in 50 gallons (1 teaspoonful per gallon) with lime-sulphur 1-7 or with Oil emulsion 2 to 4 percent (with Bordeaux mixture 3-4-50 if scab is serious)	San Jose scale, eggs of European red mite Aphids, San Jose scale, European red mite, scab.
Prepink	When first blossom buds show pink	Lime-sulphur 1 1/4 gallons in 50 gallons	Scab, in areas in which it is usually severe, or on varieties especially sus- ceptible.
Pink	Just before blossoms open	Lime-sulphur 1 1/4 to 1 1/2 gallons in 50 gallons, with lead arsenate 1 lb. in 50 gal- lons.	Leaf-chewing insects, scab.
Calyx	As soon as petals fall and before calyx lobes close	Lime-sulphur 1 1/4 to 1 1/2 gallons in 50 gallons, with lead arsenate 1 1/2 pounds in 50 gallons	Codling moth, curculio, scab and other diseases
First cover spray	3 to 4 weeks after petals fall	Same as above. In southern ap- ple areas, where blotch is prevalent, Bordeaux mixture 3-4-50 should be substituted for lime-sulphur in this ap- plication	Codling moth, curculio, scab and other diseases
<b>WARNING.</b> — The use of lead arsenate later than 4 weeks after after petal fall may leave spray residues sufficiently great to be injurious to human health. If later applications are made, the excessive residue should be removed, in commercial orchards by washing the fruit in dilute hydrochloric acid, in orchards where fruit is produced for home consumption by peeling the fruit before it is consumed.			
Second cover spray	5 to 6 weeks after petal fall	Same as above. In southern ap- ple regions Bordeaux mixture 3-4-50 is the usual fungicide in this application	As above
Mid- summer	8 to 10 weeks after petal fall	Same as above. If temperatures are above 85°F., Bordeaux mix- ture should be used.	Second-brood codling moth, apple maggot, blotch, bitter- rot, and other diseases.



## PEAR INSECTS

### San Jose Scale

The San Jose scale infests pears with the exception of the Kieffer and Le Conte varieties. The same treatment applies as described under Apple Insects.

### Pear Leaf Blister Mite

The pear leaf blister mite is usually present wherever pears are grown and frequently requires treatment on both pears and apples. The mites winter behind the bud scales and attack the unfolding leaves and young fruit in the spring, causing reddish or greenish blisterlike spots which later in the season become brown and dead. If the attack is severe, the foliage may fall, stunting the fruit and in extreme cases causing it to drop. The lime-sulphur and the oil sprays used for the San Jose scale keep the blister mite in check, lime-sulphur being considered more effective than the oil sprays.

### Codling Moth

The codling moth also attacks the pear, in some localities seriously. It should be treated as recommended for the apple, the calyx spray and the first and second cover applications of the apple-spraying schedule usually being sufficient. Pears are generally harvested earlier than the winter varieties of apple. Extreme care should therefore be taken to avoid excessive spray residues, as discussed under Apple Insects in the section devoted to the codling moth. Sprayed pears should be thoroughly washed or, in the absence of effective removal machinery, the spraying should be discontinued 4 weeks to a month after the blooming period. Lime-sulphur sometimes burns pears, and in its stead Bordeaux mixture or one of the wettable sulphurs may be used.

### Pear Slug

The pear slug is a slimy, snaillike creature which appears on the trees in May or June according to latitude. A second generation often occurs in the latter part of the summer. The pest is easily controlled by spraying or dusting the trees with lead arsenate at the strength indicated for the control of the codling moth, or by the use of nicotine and soap as suggested for the control of apple aphids.

### Pear Psylla

The pear psylla is very troublesome in some regions, especially the north-eastern part of the United States. The insects suck the sap from the foliage and leaf stalks, causing the leaves to turn yellow and later brown. Many of these leaves fall prematurely, with consequent injury to the fruit. Infested pears are usually sooty in appearance, as a result of the growth of a black fungus on the sticky excrement, or honeydew, voided by the insects. Adult psyllas hibernate in cracks in the bark of the trunk and limbs, under bark scales, or under trash on the ground in and near the orchard, and migrate to the trees on the first warm days in the spring. Applications of 3 percent lubricating-oil emulsion at this time have given satisfactory results. Many of the adult flies are killed, and the film of oil remaining on the bark reduces the number of eggs laid and kills a high percentage of the young psyllas that hatch.



## SPRAY MATERIALS

The spray materials mentioned in this circular can be obtained from local agricultural supply houses. They include the following:

Lead arsenate.— This is available chiefly in the form of a white powder. The strength of 1 pound in 50 gallons is equivalent to 3 rounded teaspoonfuls per gallon.

Lime-sulphur.—This is a cherry-red liquid. The commercial solution usually tests  $32^{\circ}$  to  $33^{\circ}$  on the Baume scale. The winter strength of 1 part of lime-sulphur to 7 parts of water is equivalent to 1 pint in each gallon of liquid. The summer strength of  $1\frac{1}{4}$  to  $1\frac{1}{2}$  gallons in 50 is equivalent to 4 fluid ounces per gallon. (1 cup contains 8 fluid ounces.)

This material is also available in dry form. Although less effective for some purposes, it is more convenient to handle. It should be diluted in accordance with the recommendations given on the label or used at a somewhat greater strength.

Wettable sulphurs.—As a substitute for lime-sulphur for the spraying of trees in foliage, there are available the so-called wettable sulphurs. They are milder in their action than lime-sulphur, and less likely to injure tender foliage but they are not so effective in the control of scab. They should be used in accordance with the directions on the label.

Oil sprays.—There are two types of oil spray, the emulsions and the miscible oils. The emulsions vary from a consistency of thin cream to that of mayonnaise. The miscible oils are similar in appearance to ordinary lubricating oil. Both types of material mix readily with water.

Nicotine sulphate.—This material may be bought in the form of a concentrated solution containing 40 percent nicotine. In mixing small quantities, it should be used at a strength of  $\frac{3}{4}$  to 1 teaspoonful in each gallon, with a small quantity of soap, or with lime-sulphur or Bordeaux mixture.

Bordeaux mixture. Bordeaux mixture is most effective if prepared immediately before use. The formula 3-4-50 means 3 pounds of bluestone (copper sulphate) and 4 pounds of fresh hydrated lime in 50 gallons of water. First dissolve the bluestone in water in a nonmetal container, preferably by suspending the chemical overnight in a cloth sack in half the required amount of water (25 gallons). Thoroughly mix the lime with enough water to make a thin paste and add to it the remaining 25 gallons of water. Then pour the bluestone solution and the suspension of lime into the tank simultaneously. Prepared Bordeaux mixtures are on the market, both in the form of pastes and as powders.

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London, 10th March 1891

My dear Mr. [Name]  
I have just received your letter of the 8th inst.

and am glad to hear that you are  
interested in the subject of the  
[Topic] and that you are  
wishing to know more about it.

I have been thinking of writing to you  
for some time, but have been so busy  
that I have not had time to do so.

I am now at the [Location] and  
am engaged in the study of the  
[Topic] and I am sure that you  
will find the information I am about to  
give you of great interest.

I have been very much interested in  
the [Topic] and I have been  
studying it for some time.

I have been very much interested in  
the [Topic] and I have been  
studying it for some time.

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